



U.S. Civilian Space Policy Priorities: Reflections 50 Years After Sputnik

Deborah D. Stine

Specialist in Science and Technology Policy

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Summary

The “space age” began on October 4, 1957, when the Soviet Union (USSR) launched Sputnik, the world’s first artificial satellite. Some U.S. policymakers, concerned about the USSR’s ability to launch a satellite, thought Sputnik might be an indication that the United States was trailing behind the USSR in science and technology. The Cold War also led some U.S. policymakers to perceive the Sputnik launch as a possible precursor to nuclear attack. In response to this “Sputnik moment,” the U.S. government undertook several policy actions, including the establishment of the National Aeronautics and Space Administration (NASA) and the Defense Advanced Research Projects Agency (DARPA), enhancement of research funding, and reformation of science, technology, engineering and mathematics (STEM) education policy.

Following the “Sputnik moment,” a set of fundamental factors gave “importance, urgency, and inevitability to the advancement of space technology,” according to an Eisenhower presidential committee. These four factors include the compelling need to explore and discover; national defense; prestige and confidence in the U.S. scientific, technological, industrial, and military systems; and scientific observation and experimentation to add to our knowledge and understanding of the Earth, solar system, and universe. They are still part of current policy discussions and influence the nation’s civilian space policy priorities—both in terms of what actions NASA is authorized to undertake and the appropriations each activity within NASA receives.

Further, the United States faces a far different world today. No Sputnik moment, Cold War, or space race exists to help policymakers clarify the goals of the nation’s civilian space program. The Hubble telescope, *Challenger* and *Columbia* space shuttle disasters, and Mars exploration rovers frame the experience of current generations, in contrast to the Sputnik launch and the U.S. Moon landings. As a result, some experts have called for new 21st century space policy objectives and priorities to replace those developed 50 years ago.

On October 15, 2008, the NASA Authorization Act of 2008 (P.L. 110-422) was signed into law. This act authorized appropriations for FY2009, and prohibited NASA from taking any steps prior to April 30, 2009, that would preclude the President and Congress from being able to continue to fly the Space Shuttle past 2010. During the 111th Congress, policymakers may discuss another authorization bill for future years, and identify priorities for civil space exploration. Little is known about the Obama Administration’s space policy priorities, and the degree to which they agree with Bush Administration policies.

If policymakers identify priorities for U.S. civil space exploration, this might help Congress determine the most appropriate balance of funding for NASA’s programs during its authorization and appropriation process. For example, if Congress believes that national prestige should be the highest priority, they may choose to emphasize NASA’s human exploration activities, such as establishing a Moon base and landing a human on Mars. If they consider scientific knowledge the highest priority, Congress may emphasize unmanned missions and other science-related activities as NASA’s major goal. If international relations are a high priority, Congress might encourage other nations to become equal partners in actions related to the International Space Station. If spinoff effects, including the creation of new jobs and markets and its catalytic effect on math and science education, are Congress’ priorities, then they may focus NASA’s activities on technological development and linking to the needs of business and industry, and expanding its role in science and mathematics education.

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C current U.S. space policy is based on a set of fundamental factors which, according to an Eisenhower presidential committee, “give importance, urgency, and inevitability to the advancement of space technology.”¹ These factors were developed fifty years ago as a direct result of the Soviet Union’s (USSR) launch of the first artificial satellite, Sputnik. This launch began the “space age” and a “space race” between the United States and USSR.

The four factors are the compelling need to explore and discover; national defense; prestige and confidence in the U.S. scientific, technological, industrial, and military systems; and scientific observation and experimentation to add to our knowledge and understanding of the Earth, solar system, and universe.² They are still part of current policy discussions and influence the nation’s civilian space policy priorities—both in terms of what actions NASA is authorized to undertake and the appropriations each activity within NASA receives.

NASA has active programs that address all four factors, but many believe that it is being asked to accomplish too much for the available resources. An understanding of how policy decisions made during the Sputnik era influence U.S. space policy today may be useful as Congress considers changing that policy. The response of Congress to the fundamental question, “Why go to space?,” may influence NASA’s programs, such as its earth-observing satellites, human exploration of the Moon and Mars, and robotic investigation of the solar system and wider universe as well as its policies on related activities, including spinoff technological development,³ science and mathematics education, international relations, and commercial space transportation.

This report describes Sputnik and its influence on today’s U.S. civilian space policy, the actions other nations and commercial organizations are taking in space exploration, and why the nation invests in space exploration and the public’s attitude toward it. The report concludes with a discussion of possible options for future U.S. civilian space policy priorities and the implication of those priorities.

Sputnik and America’s “Sputnik Moment”

On October 4, 1957, the USSR launched Sputnik, the world’s first artificial satellite. Sputnik (Russian for “traveling companion”) was the size of a basketball and weighed 183 pounds (see **Figure 1**). Sputnik’s launch and orbit⁴ still influences policy decisions 50 years later.

The USSR’s ability to launch a satellite ahead of the United States led to a national concern that the United States was falling behind the USSR in its science and technology capabilities and thus might be vulnerable to a nuclear missile attack.⁵ The resulting competition for scientific and technological superiority came to represent a competition between capitalism and communism.

¹ U.S. President (Dwight D. Eisenhower), President’s Science Advisory Committee, *Introduction to Outer Space*, March 26, 1958. p. 1, at <http://www.hq.nasa.gov/office/pao/History/monograph10/doc6.pdf>.

² *Ibid.*, pp. 1-2.

³ A spinoff is defined by NASA as “A commercialized product incorporating NASA technology or ‘know how’ which benefits the public.” For more information, see NASA, *Spinoff: 50 Years of NASA-Derived Technologies (1958-2008)*, at <http://www.sti.nasa.gov/tto/Spinoff2008/index.html>.

⁴ Sputnik 1 orbited the Earth every 96 minutes until it fell from orbit on January 4, 1958, three months after its launch. Roger D. Launius, “Sputnik and the Origins of the Space Age,” at <http://history.nasa.gov/sputnik/sputorig.html>.

⁵ Dwight D. Eisenhower Presidential Center, “Sputnik and the Space Race,” at <http://www.eisenhower.utexas.edu/dl/> (continued...)

Figure 1. Sputnik



Source: NASA, at <http://history.nasa.gov/sputnik/gallerysput.html>.

Both the 85th Congress and President Eisenhower undertook an immediate set of policy actions in response to the launch of Sputnik. Congress established the Senate Special Committee on Space and Astronautics on February 6, 1958, and the House Select Committee on Science and Astronautics on March 5, 1958—the first time since 1892 that both the House and Senate took action to create standing committees on an entirely new subject. Each committee was chaired by the Majority Leader. The Preparedness Investigating Subcommittee of the Senate Armed Services Committee was also active in analyzing the nation’s satellite and missile programs.⁶

Multiple congressional hearings were held in the three months following Sputnik, and President Eisenhower addressed the nation to assure the public that the United States was scientifically strong and able to compete in space. Within 10 months after Sputnik’s launch, the Eisenhower Administration and Congress took actions that

- established the National Aeronautics and Space Administration (NASA) through the National Aeronautics and Space Act (P.L. 85-568),⁷

(...continued)

Sputnik/Sputnikdocuments.html.

⁶ U.S. Congress, House Committee on Science and Technology, *Toward the Endless Frontier: History of the Committee on Science and Technology, 1959-79*, prepared for the Committee by Ken Hechler, committee print, 96th Cong., 2nd sess., H.Prt. 35-120, (Washington: GPO, 1980), pp. 1-28.

⁷ P.L. 85-568, The National Aeronautics and Space Act (“Space Act”), July 29, 1958, at http://www.nasa.gov/offices/ogc/about/space_act1.html.

- established the Defense Advanced Research Projects Agency (DARPA) within the Department of Defense through DOD Directive 5105.15 and National Security - Military Installations and Facilities (P.L. 85-325),⁸
- increased its appropriation for the National Science Foundation to \$134 million, nearly \$100 million higher than the previous year,⁹ and
- reformed elementary, secondary, and postsecondary science and mathematics education (including gifted education) and provided incentives for American students to pursue science, technology, engineering, and mathematics postsecondary degrees via fellowships and loans through the National Defense Education Act (P.L. 85-864).¹⁰

Figure 2 provides a timeline of some of the major policy events in the year following the Sputnik launch.

When people today speak of a “Sputnik moment,” they often refer to a rapid national response that quickly mobilizes major policy change as opposed to a response of inaction or incremental policy change. The term is also used to question inaction—as in whether or not the nation is prepared to respond to a challenge without an initiating Sputnik moment.

Why Was Sputnik So Influential?

The Sputnik launch captured the public’s attention at a time of heightened U.S. tension regarding the threat posed by the USSR and communism. Societal focus on civil defense, including “duck and cover” drills and the establishment of some personal bomb shelters, predisposed the nation towards identifying the potential threat posed by the Sputnik launch.¹¹ In this climate, many Americans became concerned that if the USSR could launch a satellite into space, it could also launch a nuclear missile capable of reaching the United States.¹²

⁸ DARPA was originally called the Advanced Research Projects Agency (ARPA). It was established by DOD Directive 5105.15 on February 7, 1958, and by Congress in P.L. 85-325 on February 12, 1958. The name was changed from ARPA to DARPA by DoD Directive on March 23, 1972. DARPA was redesignated ARPA by President Bill Clinton in an Administration document on February 22, 1993. ARPA’s name was changed back to DARPA by P.L. 104-106 on February 10, 1996. For more information about DARPA and its history, see DARPA, “Defense Advanced Research Project Agency: Technology Transition,” January 1997 at <http://www.darpa.mil/body/pdf/transition.pdf>.

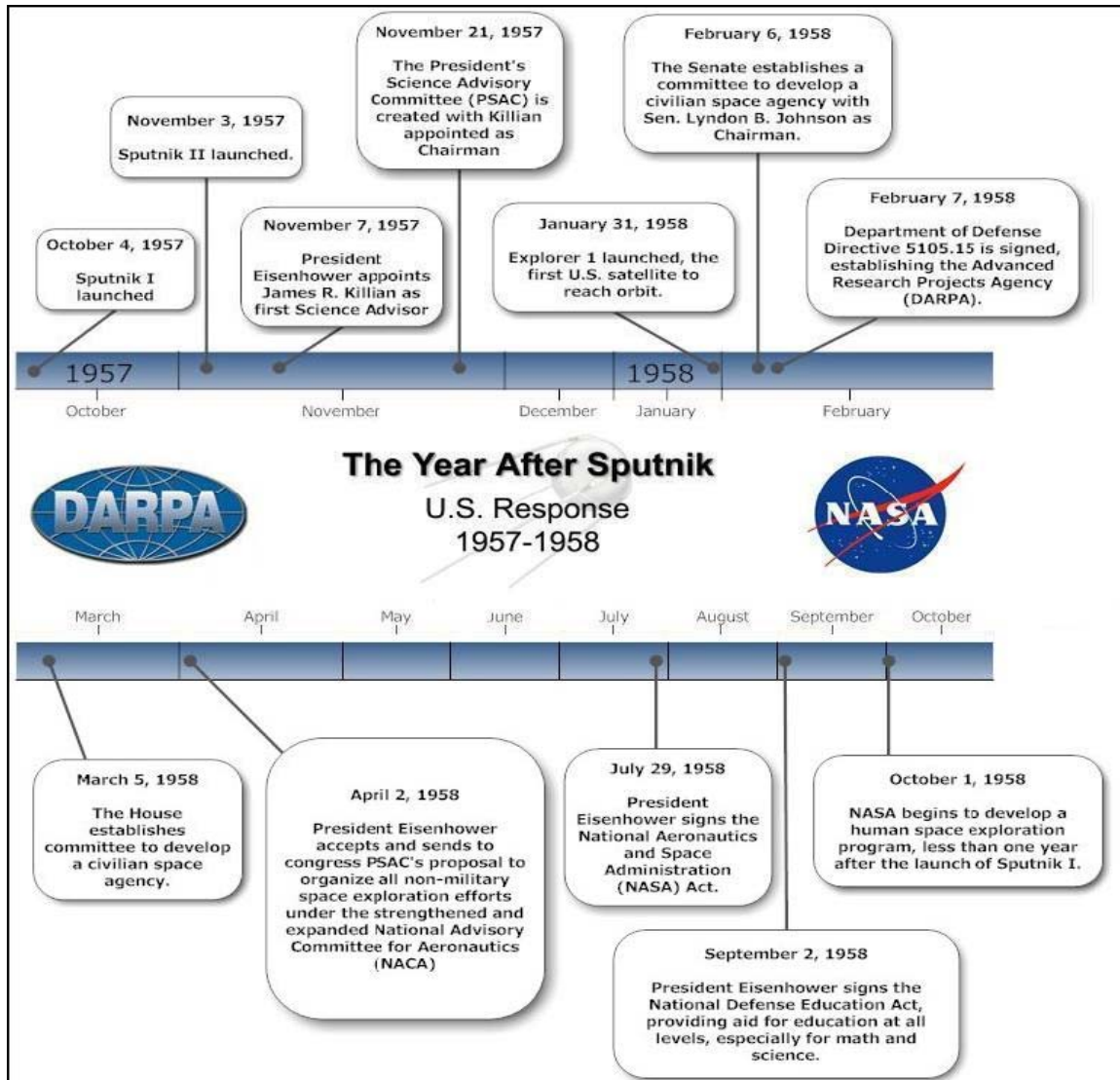
⁹ The appropriation for NSF continued to increase in future years. In 1968, it was almost \$500 million. National Science Foundation, An Overview of the First 50 years, at <http://www.nsf.gov/about/history/overview-50.jsp>.

¹⁰ P.L. 85-864, National Defense Education Act (NDEA), September 2, 1958.

¹¹ Dwight D. Eisenhower Presidential Center, “Sputnik and the Space Race,” at <http://www.eisenhower.utexas.edu/dl/Sputnik/Sputnikdocuments.html>.

¹² Council on Foreign Relations, Chronology of National Missile Defense Programs, June 1, 2002, at <http://www.cfr.org/publication/10443/>.

Figure 2. Timeline of Select Policy Events in the Year Following the Sputnik Launch



Source: Association of American Universities, at http://www.aau.edu/education/Sputnik_Timeline_2007-09-20.pdf.

Notes: DARPA was also established by Congress in P.L. 85-325.

The Sputnik launch was immediately viewed as a challenge to U.S. scientific and technological prowess. The Soviet Union launched both Sputnik and Sputnik 2 before the United States was able to attempt a satellite launch.¹³ Additionally, the Soviet launch was of a far heavier satellite than the U.S. had planned.¹⁴ The net result of the Sputnik launch was called a “Pearl Harbor for

¹³ The Project Vanguard booster tests on December 6, 1957 (rose 3 feet, caught fire) and February 5, 1958 (rose 4 miles, exploded) were unsuccessful. A new effort, Project Explorer led by Wernher von Braun, was initiated. Explorer 1 was successful, after two aborted launches, on January 31, 1958. Roger D. Launius, “Sputnik and the Origins of the Space Age,” at <http://history.nasa.gov/sputnik/sputorig.html>.

¹⁴ Sputnik 1 weighed 183 pounds. Sputnik 2 launched on November 3, 1957 weighed 1,120 pounds, carried a dog, and stayed in orbit for almost 200 days. The first satellite to be launched in the American Project Vanguard was planned to be 3.5 pounds. Roger D. Launius, “Sputnik and the Origins of the Space Age,” at <http://history.nasa.gov/sputnik/> (continued...)

American Science”—a sign that the United States was falling behind the USSR in science and technology.¹⁵ The ensuing competition in scientific and technological skills came to represent a competition to determine the political superiority of capitalism versus communism.

The Senate Majority Leader at the time, future President Lyndon B. Johnson, illustrated the concern of many Americans in his own observations of the night sky: “Now, somehow, in some new way, the sky seemed almost alien. I also remember the profound shock of realizing that it might be possible for another nation to achieve technological superiority over this great country of ours.”¹⁶

Why Is Sputnik Important to Today’s Policies?

The Sputnik launch prompted rapid development of new federal policies and programs. In particular, federal investment in NASA is still influenced by the Sputnik-era principles as illustrated in the Space Act, both in terms of what actions NASA is authorized to undertake and the extent to which each activity is funded.

In 2008, NASA was reauthorized for FY2009.¹⁷ As Congress considers future reauthorization of NASA, the status of the nation’s space policy, and the relative importance of the various objectives underlying this policy may become topics of debate.

The United States faces a far different world today than 50 years ago. No Sputnik moment, Cold War, or space race exists to help policymakers clarify the goals of the nation’s civilian space program. The Hubble telescope, *Challenger* and *Columbia* space shuttle disasters, and Mars exploration rovers frame the experience of current generations, in contrast to the Sputnik launch and the U.S. Moon landings that form the experience of older generations.

What Are the Activities of Other Nations and the Commercial Sector in Space Exploration?

According to an analysis conducted by the Space Foundation, the global space industry in 2007 generated \$251.16 billion in revenues.¹⁸ (See **Figure 3.**) The United States faces a possible new set of competitors or collaborators in civilian space exploration. China, India, Japan, Russia, and

(...continued)

sputorig.html.

¹⁵ Davis, James C., *The Human Story: Our History, From the Stone Age to Today* (New York: Harper Collins, 2004). According to Davis, the statement was made by a Japanese newspaper shortly after the event. Others called it a “technological Pearl Harbor.”

¹⁶ Roger D. Launius, “Sputnik and the Origins of the Space Age,” at <http://history.nasa.gov/sputnik/sputorig.html>.

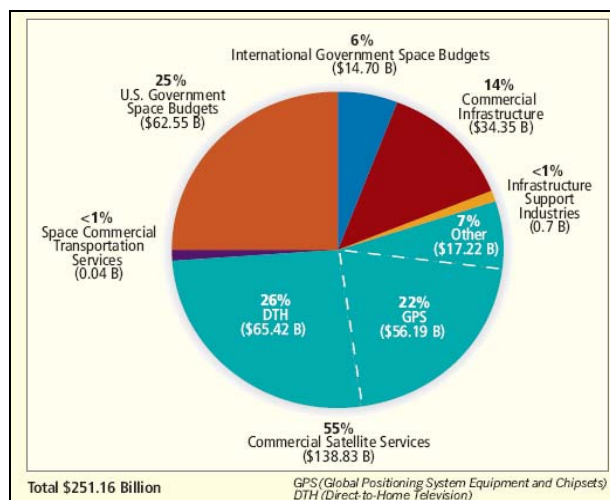
¹⁷ NASA Authorization Act of 2008 (P.L. 110-422).

¹⁸ Space Foundation, *The Space Report: Guide to Global Space Activities*, 2006, at <http://www.thespacereport.org/>. For more on the space economy, see Michael D. Griffin, Administrator, National Aeronautics and Space Administration, *The Space Economy*, NASA 50th Anniversary Lecture Series, September 17, 2007, at http://www.nasa.gov/audience/formedia/speeches/mg_speech_collection_archive_1.html.

Europe are taking an active role in space exploration as are commercial companies.¹⁹ If China is the first to land humans on the Moon and establish a Moon base in the 21st century or the European Space Agency is the first to land humans on Mars, will policymakers and the public view these activities as a loss in United States status and leadership? If so, what are the policy implications? Would such activities become this century's "Sputnik moment" that would spur further investment in U.S. space exploration activities? If not, how might this affect U.S. space policy priorities?

Future spacecraft are being developed. For example, the X-Prize Foundation Google Lunar X Prize (\$30 million) invites private teams from around the world to build a robotic rover capable of landing on the Moon.²⁰ Virgin Galactic, currently based in California with a spaceport under construction in New Mexico, has plans for SpaceShipTwo, a six-passenger spaceliner.²¹ In Europe, EADS-Astrium is developing a four-person spacecraft to make suborbital trips.²² According to press reports, a number of venture capitalists are also planning to build spaceships or develop private space programs.²³ Should these efforts prove successful, what implications might this have for U.S. space policy priorities?

Figure 3. Global Space Activity, 2007



Source: Space Foundation, *The Space Report: Guide to Global Space Activities, 2008*, at <http://www.thespacereport.org/>.

¹⁹ Peter Spotts, "Many Contestants in Latest 'Space Race' to the Moon," *Christian Science Monitor*, October 1, 2007.

²⁰ X-prize Foundation, "Google Sponsors Lunar X PRIZE to Create a Space Race for a New Generation," press release, September 13, 2007, at <http://www.xprize.org/lunar/press-release/google-sponsors-lunar-x-prize-to-create-a-space-race-for-a-new-generation>.

²¹ Virgin Galactic, Overview, at <http://www.virgingalactic.com/>. NASA has signed a memorandum of understanding with Virgin Galactic to explore the potential for collaborations on the development of space suits, heat shields for spaceships, hybrid rocket motors, and hypersonic vehicles capable of traveling five or more times the speed of sound. See NASA, "NASA, Virgin Galactic to Explore Future Cooperation," press release, February 21, 2007, at http://www.nasa.gov/home/hqnews/2007/feb/HQ_07049_Virgin_Galactic.html.

²² EADS-Astrium, "Astrium Rockets into Space Tourism," press release, June 13, 2007, at <http://www.astrium.eads.net/press-center/press-releases/astrium-rockets-into-space-tourism>.

²³ Jeremy Quittner (ed.), "I Need My Space," *Business Week*, Winter 2007, at http://www.businessweek.com/magazine/content/07_09/b4023413.htm.

What Is the Nation's Current Civilian Space Policy?

Little is known about the Obama Administration's space policy. The Obama Administration has said that it "will restore American leadership on space issues,"²⁴ but only provides details regarding its military space policy. The Government Accountability Office (GAO) indicates that a decision as to whether or not to retire the space shuttle among the top 13 issues facing President Obama. The degree to which the Obama Administration agrees with the Bush Administration space policy is unknown.

During the Bush Administration, a U.S. National Space Policy defined the key objectives of defense and civilian space policy.²⁵ This policy incorporated key elements of the Vision for Space Exploration ("Vision"), often referred to as the Moon/Mars program. In the Vision,²⁶ the President directed NASA to focus its efforts on returning humans to the Moon by 2020 and eventually sending them to Mars and "worlds beyond."²⁷ The President further directed NASA to fulfill commitments made to the 13 countries that are its partners in the International Space Station (ISS). In the 2005 NASA authorization act (P.L. 109-155), Congress directed NASA to establish a program to accomplish the goals outlined in the Vision, which are that the United States

- Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.²⁸

More specifically, the Vision included plans, via a strategy based on "long-term affordability," to

- return the Space Shuttle safely to flight (which has been accomplished),
- complete the International Space Station (ISS) by 2010 but discontinue its use by 2017,
- phase out the Space Shuttle when the ISS is complete by 2010,

²⁴ White House, "The Agenda - Defense," webpage at <http://www.whitehouse.gov/agenda/defense/>, accessed February 2, 2009.

²⁵ U.S. President (G.W. Bush), *U.S. National Space Policy*, August 31, 2006, at <http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf>. It replaced the previous space policy that had been in place for 10 years.

²⁶ U.S. President (G.W. Bush), *President Bush Announces New Vision for Space Exploration Program, Fact Sheet: A Renewed Spirit of Discovery*, January 14, 2004, at <http://www.whitehouse.gov/news/releases/2004/01/20040114-1.html>.

²⁷ Twelve U.S. astronauts walked on the Moon between 1969 and 1972. No humans have visited Mars.

²⁸ U.S. President (G. W. Bush), "A Renewed Spirit of Discovery," document, January 14, 2004, at http://www.whitehouse.gov/space/renewed_spirit.html.

- send a robotic orbiter and lander to the Moon,
- send a human expedition to the Moon (sometime between 2015-2020),
- send a robotic mission to Mars in preparation for a future human expedition, and
- conduct robotic exploration across the solar system.²⁹

NASA is developing a new spacecraft called Orion (formerly the Crew Exploration Vehicle) and a new launch vehicle for it called Ares I (formerly the Crew Launch Vehicle). An Earth-orbit capability is planned by 2014 (although NASA now considers early 2015 more likely) with the ability to take astronauts to and from the Moon following no later than 2020.

The Vision had broad implications for NASA, especially since almost all the funds to implement the initiative are expected to come from other NASA activities. Among the issues Congress is debating are the balance between NASA's exploration activities and its other programs, such as science and aeronautics research; the impact of the Vision on NASA's workforce needs; whether the space shuttle program might be ended in 2010; and if the United States might discontinue using the International Space Station.³⁰

NASA stated that its strategy is to "go as we can afford to pay," with the pace of the program set, in part, by the available funding.³¹ Affording such a program is challenging, however, with a 2006 National Research Council report finding "NASA is being asked to accomplish too much with too little." The report recommended that "both the executive and the legislative branches of the federal government need to seriously examine the mismatch between the tasks assigned to NASA and the resources that the agency has been provided to accomplish them and should identify actions that will make the agency's portfolio of responsibilities sustainable."³²

Why Invest in Space Exploration?

The **Table A-1** compares The National Aeronautics and Space Act of 1958 as amended ("Space Act"),³³ the oldest and most recent Presidential commission reports (Killian³⁴ and Aldridge³⁵), the

²⁹ NASA, *Vision for Space Exploration*, February 2004, at http://www.nasa.gov/mission_pages/exploration/main/index.html.

³⁰ CRS Report RS22625, *National Aeronautics and Space Administration: Overview, FY2008 Budget in Brief, and Key Issues for Congress*, by Daniel Morgan and Carl E. Behrens; CRS Report RL33568, *The International Space Station and the Space Shuttle*, by Carl E. Behrens; and CRS Report RS21720, *Space Exploration: Issues Concerning the "Vision for Space Exploration"*, by Marcia S. Smith.

³¹ Testimony of Michael D. Griffin, Administrator, National Aeronautics and Space Administration before the Senate Committee on Commerce, Science and Transportation Subcommittee on Space, Aeronautics and Related Sciences, Budget Hearing, U.S. Senate, February 28, 2007, at http://commerce.senate.gov/public/_files/Testimony_MichaelDGriffin_NASA_FY2008PostureStatementFINAL22707.pdf.

³² National Research Council, Space Studies Board, *An Assessment of Balance in NASA's Science Program*, Washington, DC, 2006, p. 2 http://www.nap.edu/catalog.php?record_id=11644. The NRC is in the midst of a project entitled "Rationale and Goals of the U.S. Civil Space Program." The report from this project is scheduled to be released in July 2009. For more information, see http://www7.nationalacademies.org/ssb/rationale_goals_civil_space.html.

³³ P.L. 85-568, The National Aeronautics and Space Act, July 29, 1958, at http://www.nasa.gov/offices/ogc/about/space_act1.html. Since 1958, the objectives have only had two modifications. The clause, "of the Earth and" was added to the first objective by the National Aeronautics and Space Administration Authorization Act, 1985, P.L. 98-361, § 1 10(b), 98 Stat. 422, 426 (July 16, 1984). Objective (9) was added by the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1989, P.L. 100-685, § 214, 102 Stat. 4083, 4093 (November 17, 1988). (continued...)

U.S. National Space Policy³⁶ (“Space Policy”), and the National Aeronautics and Space Administration Authorization Act of 2008 (P.L. 110-422). The analyses identify the following reasons why the United States might explore space:

- knowledge and understanding,
- discovery,
- economic growth—job creation and new markets,
- national prestige, and
- defense.

Some also include the following reasons:

- international relations, and
- education and workforce development.

Although there is broad agreement on the reasons for space exploration, there is a great deal of variation in the details. Among the chief differences in these documents are the degree to which

- discovery is the major reason for space exploration as opposed to meeting needs here on Earth;
- creation of jobs and new markets should be a major focus of NASA activities as opposed to a side effect;
- science and mathematics education and workforce development should be a goal of NASA in addition to other federal agencies; and
- relationships with other countries should be competitive or cooperative regarding space exploration.

Comparing the Aldridge Commission themes, the Space Policy goals, and the Space Act objectives on the issue of the relationship of the space program to economic growth provides some insights. While the Aldridge committee has a much broader view of the industries related to space exploration, focusing on the potential role of space exploration in job generation and new

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Objective (9) states the following: “The preservation of the United States’ preeminent position in aeronautics and space through research and technology development related to associated manufacturing processes.”

³⁴ During the Sputnik era, President Eisenhower’s Science Advisory Committee, chaired by George Killian, (“Killian Commission”) responded to the fundamental question of why the United States might undertake a national space program in its report *Introduction to Outer Space*. (U.S. President (Dwight D. Eisenhower), President’s Science Advisory Committee, *Introduction to Outer Space*, March 26, 1958. p. 2, at <http://www.hq.nasa.gov/office/pao/History/monograph10/doc6.pdf>). The President’s Science Advisory Committee is analogous to today’s President’s Council of Advisors on Science and Technology (PCAST).

³⁵ U.S. President (George W. Bush), President’s Commission on Implementation of United States Space Exploration Policy, *A Journey to Inspire, Innovate, and Discover*, June 2004. Available at http://www.nasa.gov/pdf/60736main_M2M_report_small.pdf. The commission report is named for its chair, Edward C. “Pete” Aldridge, Jr., and called the “Aldridge Commission” report.

³⁶ U.S. President (G.W. Bush), *U.S. National Space Policy*, August 31, 2006, at <http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf>.

market development, the Space Act and Space Policy focus on only one sector, the aeronautical and space vehicle industry.

The two Presidential commissions have two key differences. One is the first theme outlined in the Sputnik-era Killian Committee report: “the compelling urge of man to explore and discover.” This is quite different from the recent Aldridge Commission report, which, although indicating exploration and discovery should be among NASA goals, states that “exploration and discovery will perhaps *not* be sufficient drivers to sustain what will be a long, and at times risky, journey.” The implication is that, today, solely responding to the challenge of going to the Moon or Mars is not sufficient to energize public support for space exploration.

The second key difference is the focus of the Aldridge Commission on economic growth as a proposed space exploration theme. The Aldridge Commission identifies the ability of investments in civilian space programs to generate new jobs within current industries and spawn new markets. The contribution that federal space investments make to the nation’s economy was not a key factor identified by the Killian Committee.

As a result of its focus on economic growth as a key theme of space exploration, the Aldridge Commission recommended that “NASA’s relationship to the private sector, its organizational structure, business culture, and management processes—all largely inherited from the Apollo era—must be decisively transformed to implement the new, multi-decadal space exploration vision.” Two of its specific recommendations were that NASA recognize and implement a far larger private industry presence in space operations, with the specific goal of allowing private industry to assume the primary role of providing services to NASA, and that NASA’s centers be reconfigured as Federally Funded Research and Development Centers (FFRDCs) to enable innovation, work effectively with the private sector, and stimulate economic development.³⁷

FFRDCs are not-for-profit organizations which are financed on a sole-source basis, exclusively or substantially by an agency of the federal government, and not subject to Office of Personnel Management regulations. They operate as private non-profit corporations, although they are subject to certain personnel and budgetary controls imposed by Congress and/or their sponsoring agency. Each FFRDC is administered by either an industrial firm, a university, or a nonprofit institution through a contract with the sponsoring federal agency. FFRDC personnel are not considered federal employees, but rather employees of the organization that manages and operates the center.³⁸ NASA has not fully adopted the Aldridge Commission recommendations. NASA has 10 centers (see **Table 1**).³⁹ One, the Jet Propulsion Laboratory (JPL), is already an FFRDC and is managed by the California Institute of Technology.

³⁷ U.S. President (George W. Bush), President’s Commission on Implementation of United States Space Exploration Policy, *A Journey to Inspire, Innovate, and Discovery*, June 2004, p. 7, at http://www.nasa.gov/pdf/60736main_M2M_report_small.pdf.

³⁸ See CRS Report RL34454, *Science and Technology Policymaking: A Primer*, by Deborah D. Stine.

³⁹ For more information, see <http://education.nasa.gov/about/nasacenters/index.html>.

Table I. NASA Centers

Center	Mission Area	Location
Ames Research Center	New Technology Research	Moffett Field, CA
Dryden Flight Research Center	Flight Research	Edwards, CA
Glenn Research Center	Aeropropulsion and Communications Technologies	Cleveland, OH
Goddard Space Flight Center	Earth, the Solar System, and Universe Observations	Greenbelt, MD
Jet Propulsion Laboratory (FFRDC)	Robotic Exploration of the Solar System	Pasadena, CA
Johnson Space Center	Human Space Exploration	Clear Lake, TX, near Houston, TX
Kennedy Space Center	Prepare and Launch Missions Around the Earth and Beyond	Cape Canaveral, FL
Langley Research Center	Aviation and Space Research	Hampton, VA
Marshall Space Flight Center	Space Transportation and Propulsion Technologies	Huntsville, AL
Stennis Space Center	Rocket Propulsion Testing and Remote Sensing Technology	Hancock County, MS, near Slidell, LA

Source: NASA, <http://education.nasa.gov/about/nasacenters/index.html>

Note: FFRDC is a federally funded research and development center.

What Is the Public's Attitude Toward Space Exploration?

Some editorialists question whether investing in space exploration is relevant today.⁴⁰ Others question if NASA has the right priorities.⁴¹ Would the public care if the country's investment in space exploration ended? Does the public believe it would be better to invest in social needs here on Earth rather than space exploration? Does the public support the current prioritization of the nation's space exploration activities?

According to poll data, Americans do not rank space exploration as a high priority for federal government spending. For example, in an April 10, 2007 Harris poll, respondents were given a list of twelve federal government programs and asked to pick two which should be cut "if spending had to be cut." Space programs led the list (51%), followed by welfare programs (28%), defense spending (28%), and farm subsidies (24%).⁴² Space exploration was also near the bottom

⁴⁰ See, for example, Anne Applebaum, "Mission to Nowhere," *Washington Post*, January 7, 2004, p. A21.

⁴¹ See, for example, Gregg Easterbrook, "How NASA Screwed Up (And Four Ways to Fix It)," *Wired*, May 22, 2007, at http://www.wired.com/science/space/magazine/15-06/ff_space_nasa; *The Economist*, "Spacemen Are from Mars," September 27, 2007, at http://www.economist.com/opinion/displaystory.cfm?story_id=9867224.

⁴² Harris Interactive, "Closing the Budget Deficit: U.S. Adults Strongly Resist Raising Any Taxes Except "Sin Taxes" (continued...)

of a University of Chicago National Opinion Research Center survey reported in January 2007 that asked Americans about how they would prioritize federal spending.⁴³

On the other hand, Americans are interested in space exploration. According to a May 2008 Gallup Poll,⁴⁴ sponsored by the Coalition for Space Exploration, most Americans (69%) believe that the space program benefits the nation's economy by inspiring young people to consider STEM education, and believe that the benefits of space exploration outweigh the risks of human space flight (68%). The poll also found that most Americans (67%) indicated that they would not be concerned if the United States loses its leadership in space exploration to China, while almost half (47%) of the public surveyed expressed concern regarding the five-year gap between the end of the space shuttle program and the first scheduled launch of the Constellation program. Just over half (52%) of those surveyed in the Gallup Poll said they would support increasing NASA's budget from 0.6% to 1.0% of the federal budget; however, when the public was asked how willing they would be to support an increase in taxes if the money was to go to NASA to help close the budget deficit, more than half (57%) reported they would not be willing.

NASA's Office of Strategic Communication funded several analyses of the public's attitude toward space exploration based on focus groups⁴⁵ and a survey,⁴⁶ the results of which were presented in June 2007.⁴⁷ According to an analysis conducted for NASA, the focus group participants were ambivalent about going to the Moon and Mars and wanted to know why these missions were important. Reasons such as leadership, legacy, and public inspiration were found to be less persuasive, especially for future Moon exploration, than NASA-influenced technologies. Most participants agreed that partnership with other countries would be beneficial, but doubted whether it can be achieved realistically.

In addition, one of the analysis conducted for NASA found that most survey respondents rated NASA-influenced technologies⁴⁸ as somewhat or extremely relevant to them. Over 52% of

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Or Cutting Major Programs," press release, April 10, 2007, at http://www.harrisinteractive.com/harris_poll/index.asp?PID=746. The poll was of 2,223 adults surveyed online between March 6 and 14, 2007. This online survey is not based on a probability sample and therefore no theoretical sampling error can be calculated.

⁴³ University of Chicago, "Americans Want to Spend More on Education, Health," press release, January 10, 2007, at <http://www-news.uchicago.edu/releases/07/070110.gss.shtml>. The General Social Survey, supported by the National Science Foundation, has been conducted since 1973, and is based on face-to-face interviews of randomly selected people who represent a scientifically accurate cross section of Americans. For the 2006 survey, 2,992 people were interviewed and asked a wide variety of questions in addition to those related to spending priorities.

⁴⁴ Coalition for Space Exploration, *2008 Gallup Poll: American Support for Space Exploration is Strong*, at <http://www.spacecoalition.com/files/gallupolls/final%20report-june%2008.pdf>.

⁴⁵ The focus groups were professionally moderated by Dr. Stephen Everett of the Everett Group, Inc., in consultation with ViaNovo. The six focus groups were located in San Diego, Kansas City, and Philadelphia.

⁴⁶ The professionally conducted telephone survey was of 1,001 U.S. adults in February 2007. The margin of error was $\pm 3.2\%$. The survey was conducted by Dr. Mary Lynne Dittmar of Dittmar Associates, in consultation with ViaNovo.

⁴⁷ Robert Hopkins, "Strategic Communications Framework Implementation Plan," powerpoint presentation, NASA, Office of Strategic Communications, June 26, 2007, at <http://www.spaceref.com/news/viewsr.html?pid=24646>.

⁴⁸ An example of a NASA-influenced technology (commonly called "spinoff") mentioned in the survey that had significant results is a smoke alarm. According to NASA, in the 1970s NASA needed a smoke and fire detector with adjustable sensitivity for Skylab, America's first space station. Honeywell developed the device for NASA and then made it available commercially so that consumers could avoid "nuisance" alarms while cooking. Other devices in the survey were advanced breast cancer imaging, heart defibrillators, weather satellites, remote-controlled robots, global positioning system, cordless tools, satellite radio, and DirecTV. See <http://www.sti.nasa.gov/tto/> for more details on NASA's spinoffs. See a list of NASA's top 20 spinoffs in the last five years at <http://www.ipp.nasa.gov/> (continued...)

participants said such technologies were a “very strong” reason to go to space. In contrast, the public’s response to a mission to send humans to the Moon by the year 2020 was less strong with 15% of respondents very excited and 31% somewhat excited. Results for a mission to send humans to the Mars were similar to those for the Moon.

The public opinion analysis has found that there are generational differences in regard to NASA’s proposed activities. For example, NASA’s base support came from those who encompass “The Apollo Generation” (45-64 year olds), the majority (79%) of whom support NASA’s new space exploration mission, particularly the return to the Moon. By contrast, the majority (64%) of those between 18-24 years of age are uninterested or neutral about a human Moon mission. Those between 25 and 44 years of age are approximately evenly split between those who are interested/excited and those who are either uninterested or neutral. Those over 65 were more likely to be neutral or disinterested in a Moon mission, with those over 75 years of age the least interested of all age groups.⁴⁹

What Are the Nation’s Priorities for Civilian Space Exploration and Its Implications for Future Space Policy?

Current U.S. civilian space policy is based on a set of fundamental objectives in the Space Act, based on policy discussions that occurred following the launch of Sputnik over 50 years ago. Those objectives are still part of current policy discussions and influence the nation’s civilian space policy priorities—both in terms of what actions NASA is authorized to undertake and the degree of appropriations each activity within NASA receives. NASA has active programs that address all its objectives, but many believe that it is being asked to accomplish too much for the available resources.

NASA was last reauthorized in 2008 for FY2009.⁵⁰ Thus, the reauthorization of NASA for FY2010 and beyond, along with a new Presidential Administration, may provide an opportunity for Congress to rethink the nation’s space policy. The goals of the nation’s investment in space exploration may be a key factor in determining the focus of NASA’s activities and the degree of funding appropriated for its programs. Congress and outside experts have concerns as to whether the United States can afford to implement President Bush’s Vision for Space Exploration without adversely influencing NASA’s other programs.⁵¹ Congress may need to make challenging

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spinoff_top_20a.pdf.

⁴⁹ Ibid., p. 9. Robert Hopkins, “Strategic Communications Framework,” powerpoint presentation, NASA, Office of Communications Planning, February 2007, at <http://images.spaceref.com/news/2007/feb07.stratcomm.pdf>. M. L. Dittmar, *The Market Study for Space Exploration*, (Houston, TX: Dittmar Associates, Inc., 2004), pp. 26-29 (age data) and pp. 8-11 (Executive Summary). M. L. Dittmar, “Engaging the 18-25 Generation: Educational Outreach, Interactive Technologies, and Space”. Paper #2006-7303 in Proceedings of AIAA Space 2006, September 19-21, (San Jose, California. Washington, D.C.: AIAA, 2006). Paper and presentation available at http://www.dittmar-associates.com/Paper_Downloads.htm.

⁵⁰ P.L. 109-155, NASA Authorization Act of 2005, December 30, 2005.

⁵¹ See earlier discussion for Senate and House Committee on Appropriations report language; also Lennard Fisk, Chair, Space Studies Board, National Research Council and Thomas M. Donahue Collegiate Professor of Space Science, (continued...)

decisions to determine how to reap the most benefit from the nation's civilian space program investment. These decisions might answer questions such as

- What are the priorities among the many reasons for U.S. space exploration? For example, what might be the priority ranking among the previously identified reasons as to why the United States might explore space—knowledge and understanding, discovery, economic growth, national prestige, defense, international relations, and education and workforce development?
- What implications would this prioritization have for NASA's current and future budgets and the balance among its programs? For example, what is the proper balance between human and robotic space activities?
- What influence might the timing of other countries' space exploration activities have on U.S. policy? For example, what would be the impact of the United States, China, or another country, or a commercial organization, establishing the first Moon base or landing on Mars?

New objectives and priorities might help determine NASA's goals. This, in turn, might potentially help Congress determine the most appropriate balance of funding available among NASA's programs during its authorization and appropriation process. For example, if Congress believes that national prestige should be the highest priority, they may choose to emphasize NASA's human exploration activities, such as establishing a Moon base and landing a human on Mars. If they consider scientific knowledge the highest priority, Congress may emphasize unmanned missions and other science-related activities as NASA's major goal. If international relations are a high priority, Congress might encourage other nations to become equal partners in actions related to the International Space Station. If spinoff effects, including the creation of new jobs and markets and its catalytic effect on math and science education, are Congress' priorities, then they may focus NASA's activities on technological development and linking to the needs of business and industry, and expanding its role in science and mathematics education.

Congressional Activities

On October 15, 2008, the NASA Authorization Act of 2008 (P.L. 110-422) was signed into law.⁵² This act authorized appropriations for FY2009, and prohibited NASA from taking any steps prior to April 30, 2009, that would preclude the President and Congress from being able to continue to fly the Space Shuttle past 2010. When the law was passed, the Chair of the House Science and Technology Committee stated

The [Space Shuttle] provision should not be construed as a congressional endorsement of extending the life of the Shuttle program beyond the additional flight added by this bill to deliver the AMS [Alpha Magnetic Spectrometer] to the International Space Station. Rather, it reflects our common belief that the decision of whether or not to extend the Shuttle past its

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University of Michigan, *The President's Vision for Space Exploration: Perspectives from a Recent NRC Workshop on National Space Policy*, Testimony before the House Committee on Science, March 10, 2004, at <http://science.house.gov/CommDocs/hearings/full104/mar10/fisk.pdf>.

⁵² For more information, see CRS Report RS22818, *National Aeronautics and Space Administration: Overview, FY2009 Budget, and Issues for Congress*, by Daniel Morgan and Carl E. Behrens.

planned 2010 retirement date should be left to the next President and Congress, especially since both of the Presidential candidates have asked for the flexibility to make that decision.⁵³

During the 111th Congress, policymakers may discuss another authorization bill for future years, and identify new priorities for civil space exploration.

H.Res. 67 would recognize and commend NASA, the Jet Propulsion Laboratory (JPL), and Cornell University for the success of the Mars Exploration Rovers, Spirit and Opportunity, on the 5th anniversary of the Rovers' successful landing. H.R. 255, the NASA 50th Anniversary Commemorative Coin Act, would require the Secretary of the Treasury to mint coins in commemoration of the 50th anniversary of the establishment of NASA.

The Federal Ocean Acidification Research And Monitoring Act of 2009 (H.R. 14, S. 173) would require that the NASA Administrator ensure that space-based monitoring assets are used in as productive a manner as possible for monitoring of ocean acidification and consistent with a strategic research, and encourage coordination of the Agency's ocean acidification activities with such activities of other nations and international organizations. As passed by the Senate, the same provision is within the Omnibus Public Land Management Act of 2009 (S. 22).

⁵³ House Committee on Science and Technology, "House Sends NASA Bill to President's Desk, Reaffirms Commitment to Balanced and Robust Space and Aeronautics Program," press release, September 27, 2008 at <http://science.house.gov/press/PRArticle.aspx?NewsID=2309>.

Appendix. Possible U.S. Civilian Space Policy Objectives

Table A-1. Possible U.S. Civilian Space Policy Objectives: Comparison of Selected Extracts from Historical and Current Space Policy Documents

Possible U.S. Civilian Space Policy Objectives	Space Act Objectives (July 1958, as amended)	Eisenhower Administration “Killian Committee” Factors (March 1958)	“Aldridge Commission” Themes (2004)	G.W. Bush Administration “Space Policy” Goals (2006)	NASA Authorization Act (P.L. 110-422) Findings (2009)
Knowledge and Understanding	“(1) The expansion of human knowledge of the Earth and of phenomena in the atmosphere and space.”	“Fourth, space technology affords new opportunities for scientific observation and experiment which will add to our knowledge and understanding of the earth, the solar system, and the universe.”	<p>“Exploring the Moon, Mars, and beyond is a great journey worthy of a great nation.</p> <p>The impulse to explore the unknown is a human imperative, and a notable part of what animates us as a people. This endeavor presents an opportunity to inspire a new generation of American explorers, scientist, entrepreneurs, and innovators.”</p>	“Increase the benefits of civil exploration, scientific discovery, and environmental activities.”	<p>“(1) NASA is and should remain a multimission agency with a balanced and robust set of core missions in science, aeronautics, and human space flight and exploration.”</p> <p>“(3) Investment in NASA’s programs, like investments in other Federal science and technology activities, is an investment in our future.”</p> <p>“(9) NASA’s scientific research activities have contributed much to the advancement of knowledge, provided societal benefits, and helped train the next generation of scientists and engineers, and those activities should continue to be an important priority.”</p>
Discovery	“(2) The improvement of the usefulness, performance, speed, safety, and efficiency of	“The first of these factors is the compelling urge of man to explore and to discover, the thrust of	“Despite the spiritual, emotional, and intellectual appeal of a journey to space—exploration and	“Implement and sustain an innovative human and robotic exploration program with the	“(4) Properly structured, NASA’s activities can contribute to an improved quality of life,

Possible U.S. Civilian Space Policy Objectives	Space Act Objectives (July 1958, as amended)	Eisenhower Administration "Killian Committee" Factors (March 1958)	"Aldridge Commission" Themes (2004)	G.W. Bush Administration "Space Policy" Goals (2006)	NASA Authorization Act (P.L. 110-422) Findings (2009)
	<p>aeronautical and space vehicles."</p> <p>"(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space."</p>	<p>curiosity that leads men to try to go where no one has gone before. Most of the surface of the Earth has now been explored and men now turn to the exploration of outer space as their next objective."</p>	<p>discovery will perhaps <i>not</i> be sufficient drivers to sustain what will be a long, and at times risky, journey. We must also undertake this mission for pragmatic, but no less compelling reasons, which have everything to do with life here on Earth."</p>	<p>objective of extending human presence across the solar system."</p>	<p>economic vitality, United States leadership in peaceful cooperation with other nations on challenging undertakings in science and technology, national security, and the advancement of knowledge."</p> <p>"(10) NASA should make a sustained commitment to a robust long-term technology development activity. Such investments represent the critically important "seed corn" on which NASA's ability to carry out challenging and productive missions in the future will depend."</p>
Economic Growth—Job Creation and New Markets	<p>"(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes."</p>	<p>Not discussed.</p>	<p>"Further space exploration will generate new jobs within current industries and will likely spawn entire new markets involving leading-edge manufacturing and flight support services.... As one impressive labor leader testified to the Commission, 'every dollar spent on space is a dollar spent here on Earth.' This focus is good for jobs, good for the economy, and good for American families."</p>	<p>"Enable a dynamic, globally competitive domestic commercial space sector in order to promote innovation, strengthen U.S. leadership, and protect national, homeland, and economic security."</p>	<p>"(2) Investment in NASA's programs will promote innovation through research and development, and will improve the competitiveness of the United States."</p> <p>"(12) Commercial activities have substantially contributed to the strength of both the United States space program and the national economy, and the development of a healthy and robust United States commercial space sector</p>

Possible U.S. Civilian Space Policy Objectives	Space Act Objectives (July 1958, as amended)	Eisenhower Administration "Killian Committee" Factors (March 1958)	"Aldridge Commission" Themes (2004)	G.W. Bush Administration "Space Policy" Goals (2006)	NASA Authorization Act (P.L. 110-422) Findings (2009)
National Prestige	<p>"(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere."</p> <p><i>"(9) The preservation of the United States' preeminent position in aeronautics and space through research and technology development related to associated manufacturing processes."</i>^a</p>	"Third, there is the factor of national prestige. To be strong and bold in space technology will enhance the prestige of the United States among the peoples of the world and create added confidence in our scientific, technological, industrial, and military strength."	"Exploring the Moon, Mars, and beyond is a great journey worthy of a great nation. The impulse to explore the unknown is a human imperative, and a notable part of what animates us as a people."	"Strengthen the nation's space leadership and ensure that space capabilities are available in time to further U.S. national security, homeland security, and foreign policy objectives."	<p>should continue to be encouraged."</p> <p>"(6) NASA should undertake a program of aeronautical research, development, and where appropriate demonstration activities with the overarching goals of—</p> <p>(A) ensuring that the Nation's future air transportation system can handle up to 3 times the current travel demand and incorporate new vehicle types with no degradation in safety or adverse environmental impact on local communities;</p> <p>(B) protecting the environment;</p> <p>(C) promoting the security of the Nation; and</p> <p>(D) retaining the leadership of the United States in global aviation."</p> <p>"(8) Developing United States human space flight capabilities to allow independent American access to the International Space Station, and to explore</p>

Possible U.S. Civilian Space Policy Objectives	Space Act Objectives (July 1958, as amended)	Eisenhower Administration "Killian Committee" Factors (March 1958)	"Aldridge Commission" Themes (2004)	G.W. Bush Administration "Space Policy" Goals (2006)	NASA Authorization Act (P.L. 110-422) Findings (2009)
					beyond low Earth orbit, is a strategically important national imperative, and all prudent steps should thus be taken to bring the Orion Crew Exploration Vehicle and Ares I Crew Launch Vehicle to full operational capability as soon as possible and to ensure the effective development of a United States heavy lift launch capability for missions beyond low Earth orbit. "
Defense	"(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency."	"Second, there is the defense objective for the development of space technology. We wish to be sure that space is not used to endanger our security. If space is to be used for military purposes, we must be prepared to use space to defend ourselves."	"Much of the United States' current military strength and economic security rests on our technological leadership. Our technological and industrial base must constantly be renewed. Therefore, the United States must continue to lead, especially in those industries that require, and therefore build, technology skills."	"Enable unhindered U.S. operations in and through space to defend our interests there." "Enable a robust science and technology base supporting national security, homeland security, and civil space activities."	"(13) It is in the national interest for the United States to have an export control policy that protects the national security while also enabling the United States aerospace industry to compete effectively in the global market place and the United States to undertake cooperative programs in science and human space flight in an effective and efficient manner."
International Relations	"(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this act and in the peaceful application of the results thereof."	Not discussed.	"Although the era of Sputnik has given way to an age of international cooperation in space, it remains a competitive frontier ... Other nations, against whom we	"Encourage international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of	"(5) NASA should assume a leadership role in a cooperative international Earth observations and research effort to address key research issues associated with climate

Possible U.S. Civilian Space Policy Objectives	Space Act Objectives (July 1958, as amended)	Eisenhower Administration “Killian Committee” Factors (March 1958)	“Aldridge Commission” Themes (2004)	G.W. Bush Administration “Space Policy” Goals (2006)	NASA Authorization Act (P.L. 110-422) Findings (2009)
			compete for jobs in the global economy, are also intent on exploring space. If not us, someone else will lead in the exploration, utilization, and ultimately, the commercialization of space, as we sit idly by.”	space, as well as to advance national security, homeland security, and foreign policy objectives.”	change and its impacts on the Earth system.” “(7) Human and robotic exploration of the solar system will be a significant long-term undertaking of humanity in the 21 st century and beyond, and it is in the national interest that the United States should assume a leadership role in a cooperative international exploration initiative.”
Education and Workforce Development	“(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.”	Not discussed.	“Long-term competitiveness requires a skilled workforce. The space exploration vision can be a catalyst for a much-needed renaissance in math and science education in the United States.”	Not discussed.	“(11) NASA, through its pursuit of challenging and relevant activities, can provide an important stimulus to the next generation to pursue careers in science, technology, engineering, and mathematics.”

Sources: “Space Act”: P.L. 85-568, The National Aeronautics and Space Act, July 29, 1958. The unamended act is available at <http://www.hq.nasa.gov/office/pao/History/spaceact.html>; the amended act is available at http://www.nasa.gov/offices/ogc/about/space_act1.html. This analysis focuses on the objectives section. “Killian Committee”: U.S. President (Dwight D. Eisenhower), President’s Science Advisory Committee, *Introduction to Outer Space*, March 26, 1958, p. 2. Available at <http://www.hq.nasa.gov/office/pao/History/monograph10/doc6.pdf>. “Aldridge Commission”: U.S. President (George W. Bush), President’s Commission on Implementation of United States Space Exploration Policy, *A Journey to Inspire, Innovate, and Discover*, June 2004, p. 11. Excerpts are from the section entitled “Why Go?”. Available at http://www.nasa.gov/pdf/60736main_M2M_report_small.pdf. “Space Policy”: U.S. President (G.W. Bush), U.S. National Space Policy, August 31, 2006, at <http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf>. Excerpts are from section 3, “United States Space Policy Goals.” NASA Authorization Act: P.L. 110-422, National Aeronautics and Space Administration Authorization Act of 2008, October 15, 2008. This analysis focuses on Section 2, Findings.

Notes: Excerpts are selected to reflect the general tone of text and are not necessarily the only language discussing these issues.

- a. The words in *italics* in the “Space Act” column show the changes made to the objectives since 1958.

Author Contact Information

Deborah D. Stine
Specialist in Science and Technology Policy
dstine@crs.loc.gov, 7-8431